E290-xxxTxxS User Manual

PAN3060 433/470/868/915 MHz Wireless Module



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1 Product Overview

1.1 Product Introduction

E290-xxxTxxS series is a new generation of wireless modules developed by Chengdu Ebyte Electronic Technology Co., Ltd. It is a wireless serial port module (UART) based on the PANCHIP PAN3060 RF chip. It has multiple transmission modes and the operating frequency bands are 410.125 ~ 493.125MHz and 850.125 ~ 930.125MHz . The spread spectrum technology uses ChirpIoT™ and TTL level output.

E290-xxxTxxS adopts the new generation of ChirpIoT™ spread spectrum technology, supports half-duplex wireless communication , and has the characteristics of high anti-interference and high sensitivity; supports wake-up over the air, wireless configuration, automatic relay, communication key , AT command, IAP upgrade and other functions, supports sub-packet length setting, and can provide customized development services .



Figure 1: E290-400T20S



Figure 2: E290-900T20S



Figure 3: E290-400T30S

1.2 Features

- Support AT commands , which makes it more convenient to use;
- method based on ChirpIoT™ brings a longer communication distance and stronger anti-interference ability ;
- Supports automatic relay networking, multi-level relay is suitable for ultra-long-distance communication , and multiple networks can run simultaneously in the same area ;
- Supports users to set communication keys by themselves, which cannot be read, greatly improving the confidentiality of user data;
- Support RSSI signal strength indication function , which is used to evaluate signal quality, improve communication network, and measure distance;
- Support wireless parameter configuration, remotely configure or read wireless module parameters by sending command data packets wirelessly ;
- Supports single-point air wake-up, which is an ultra-low power consumption function suitable for battery-powered applications;
- Supports fixed-point transmission, broadcast transmission, and channel monitoring;
- Supports deep sleep, in which the power consumption of the whole machine is about 2 u A ;
- E290-400T20S and E290-400T30S support the global license-free ISM 433MHz frequency band and the 470MHz meter reading frequency band;
- of E290-900T20S is 850.125～930.125MHz, and the factory default is 868.125MHz.
- Under ideal conditions, the communication distance can reach 10 km;
- The parameters are saved when power is off , and the module will work according to the set parameters after power is turned on again ;
- Efficient watchdog design, once an abnormality occurs, the module will automatically restart and continue to work according to the previous parameter settings ;

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- Supports data transmission rates of 2.4 k to 62.5 k bps;
- Support IAP upgrade, which makes firmware update more convenient;
- Airspeed adaptation, if certain conditions are met, any airspeed gear can be configured and can communicate with each other;
- Industrial standard design, supports long-term use at -40 ~ + 85 ℃ ;

1.3 Application Scenario

- Home security alarm and remote keyless entry;
- Smart home and industrial sensors, etc.
- Wireless alarm security system ;
- Building automation solutions;
- Wireless industrial remote control;
- Healthcare products;
- Advanced Metering Infrastructure (AMI) .

2 Specifications

2.1 RF parameters

RF parameters	Unit	Model			Remark
		E290-400T20S	E290-400T30S	E290-900T20S	
Maximum transmit power	dBm	20	30	20	-
Receiving sensitivity	dBm	-125	-133～-135	-125	Air rate is 2.4 kbps
Reference distance	m	5k	10k	5k	Clear and open air, antenna gain 5dBi, antenna put in a height of 2.5 meters, air rate 2.4 kbps .
Working frequency band	MHz	410.125～493.125	410.125～493.125	850.125～930.125	-
Air speed	bps	2.4K～62.5K	2.4K～62.5K	2.4K～62.5K	programmable control by user
Blocking power	dBm	10	10	10	There is a risk of burning when used at close range
Launch length	Btye	240	240	240	The command can be set to send packets of 32/64/128/240 bytes
Cache capacity	Btye	500	500	500	

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2.2 Electrical parameters

Electrical parameters			Unit	Model			Remark
				E290-400T20S	E290-400T30S	E290-900T20S	
Operating voltage			V	2.6～5.5	3.3～5.5	2.6～5.5	≥ 5 V can guarantee the output power , and exceeding 5.5 V may burn the module .
Communication level			V	3.3V	3.3V	3.3V	Using 5V TTL may burn out
Power consumption	Emission current		mA	120	610	120	Fixed load instantaneous power consumption , antenna measurement results are different
	Receiving current	DCDC mode	mA	6.1	13	6.1	-
		LDO Mode		10.2	16	10.2	
	Sleep current		uA	2	3	2	Software shutdown
temperature	Operating temperature		℃	-40～+85			Industrial-grade design
	Storage temperature		℃	-40～+85			Industrial-grade design

2.3 Hardware Parameters

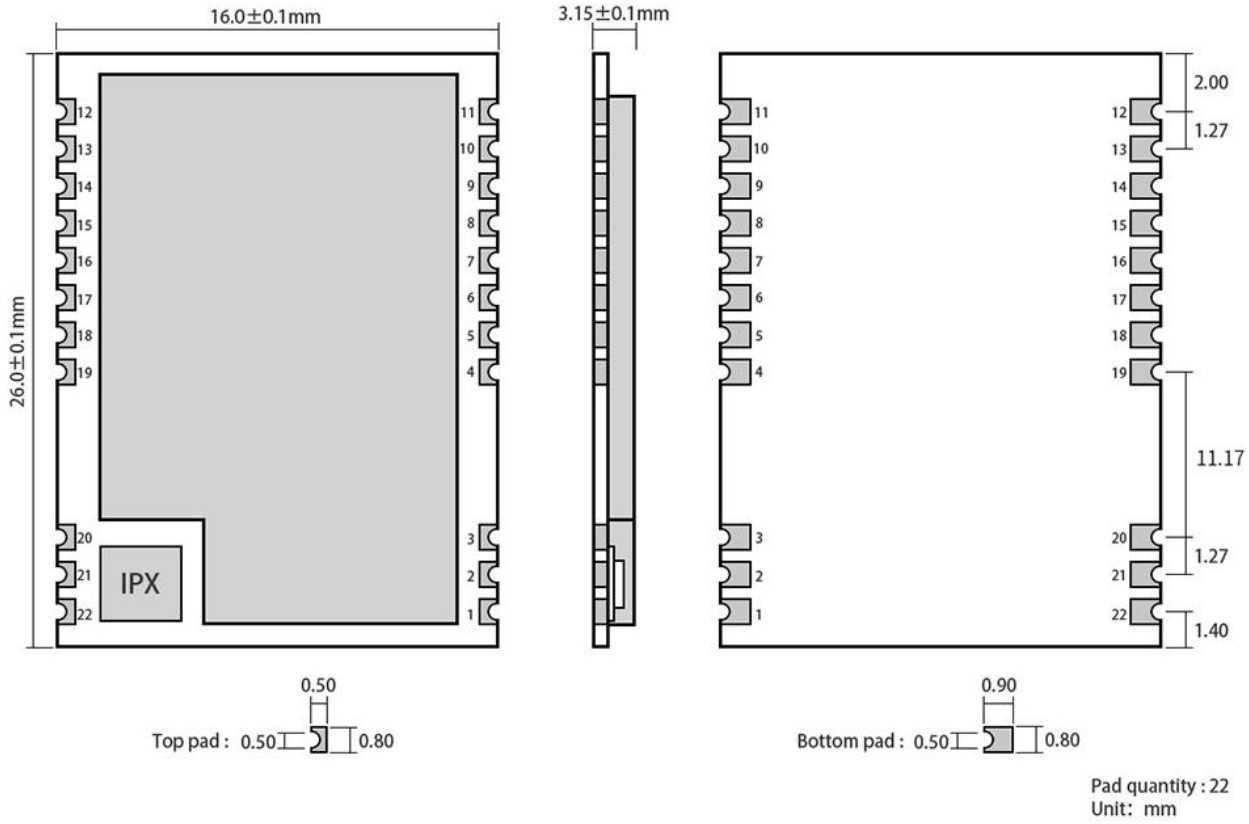
Hardware Parameters	model			Remark
	E290-400T20S	E290-400T30S	E290-900T20S	
Crystal frequency	32MHz	32MHz	32MHz	Industrial grade high precision crystal oscillator
Modulation	ChirpIoT™	ChirpIoT™	ChirpIoT™	Next-generation ChirpIoT™ modulation technology
Interface	1.27mm stamp hole	1.27mm stamp hole	1.27mm stamp hole	
Communication interface	UART Serial Port	UART Serial Port	UART Serial Port	TTL level
Packaging	SMD	SMD	SMD	-
Antenna interface	IPEX/Stamp Hole	IPEX/Stamp Hole	IPEX/Stamp Hole	Equivalent impedance is about 50 Ω
size	16*26 mm	40.5 * 25 mm	16*26 mm	±0.2mm
Product Net Weight	2.37g	5.8g	2.37g	± 0.05 g

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3 Mechanical dimensions and pin definition

3.1 E290-400T20S &E290-900T20S



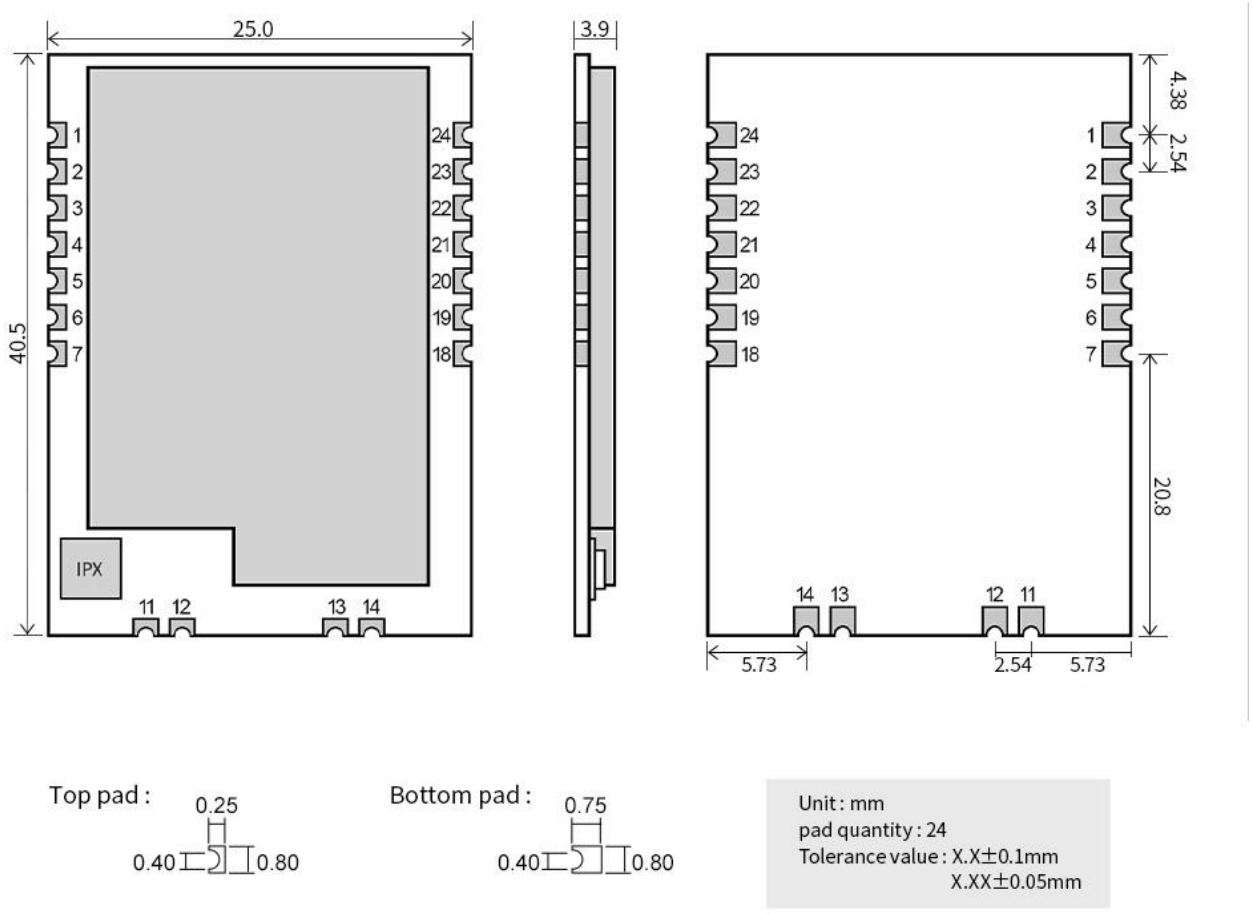
Pin number	Pin Name	Pin Direction	Pin Purpose
1	GND	-	Module ground wire
2	GND	-	Module ground wire
3	GND	-	Module ground wire
4	GND	-	Module ground wire
5	M0	Input (pull-up)	Cooperate with M1 to determine the 4 working modes of the module (cannot be left floating, can be grounded if not used)
6	M1	Input (pull-up)	Cooperate with M0 to determine the 4 working modes of the module (cannot be left floating, can be grounded if not used)
7	RxD	enter	TTL serial port input, connected to the external TXD output pin;
8	TXD	Output	TTL serial port output, connected to the external RXD input pin;
9	AUX	Input/ Output	Used to indicate the working status of the module ; it is forbidden to be low level when powered on, otherwise it will enter the firmware upgrade mode ; The user wakes up the external MCU, and the power-on self-test initialization

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			period outputs a low level; (can be left floating)
10	VCC	-	Module power positive reference, voltage range: 2.6 ~ 5.5V DC
11	GND	-	Module ground wire
12	RST	-	Module reset pin, pull low for 1ms to reset
13	GND	-	Module ground wire
14	NC	-	Floating , not grounded
15	NC	-	Floating, not grounded
16	NC	-	Floating, not grounded
17	NC	-	Floating, not grounded
18	NC	-	Floating, not grounded
19	GND	-	Module ground wire
20	GND	-	Module ground wire
21	ANT	-	antenna
22	GND	-	Module ground wire

3.2 E290-400T30S



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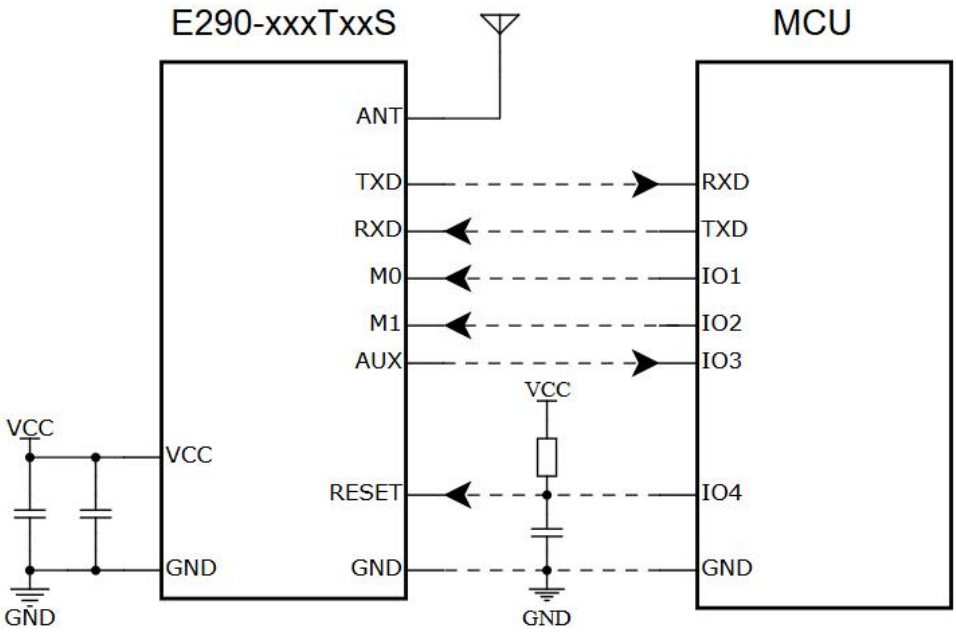
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Pin number	Pin Name	Pin Direction	Pin Purpose
1	GND	Input	Module ground wire
2	VCC	Input	Module power positive reference, voltage range: 3.3～5.5V DC
3	AUX	Output	Used to indicate the working status of the module; the user wakes up the external MCU, and outputs a low level during the power-on self-test initialization period; (can be left floating)
4	TXD	Output	TTL serial port output, connected to external RXD input pin;
5	RXD	Input	TTL serial port input, connected to external TXD output pin;
6	M1	Input (very weak pull-up)	Cooperate with M0 to determine the 4 working modes of the module (cannot be left floating, can be grounded if not used)
7	M0	Input (very weak pull-up)	Cooperate with M1 to determine the 4 working modes of the module (cannot be left floating, can be grounded if not used)
11	ANT	Output	Antenna interface (high frequency signal output, 50 ohm characteristic impedance)
12	GND	-	Fixed
13	GND	-	Fixed
14	GND	-	Fixed
18	NC	-	SWCLK Clock pin when the program is loaded (suspended, no need to connect by the user)
19	NC	-	SWDIO data pin when program is loaded (suspended, user does not need to connect)
20	NC	-	GPIO/RS485_EN
21	NC	-	MCU_VDD Power pin for program download (suspended, no need for user to connect)
22	RESET	Input	Module reset pin
23	GND	Input	Fixed Ground
24	NC	-	Empty feet

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4 Recommended Connection Diagram



Number	Brief connection instructions between the module and the MCU (the above figure takes the STM8L MCU as an example)
1	The wireless serial port module is TTL level, please connect it to the TTL level MCU.
2	Some 5V microcontrollers may require 4-10K pull-up resistors to be added to the TXD and AUX pins of the module.
3	The AUX pin cannot be low level when powered on, otherwise it will enter firmware upgrade mode.

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5 Functional Details

5.1 Working mode

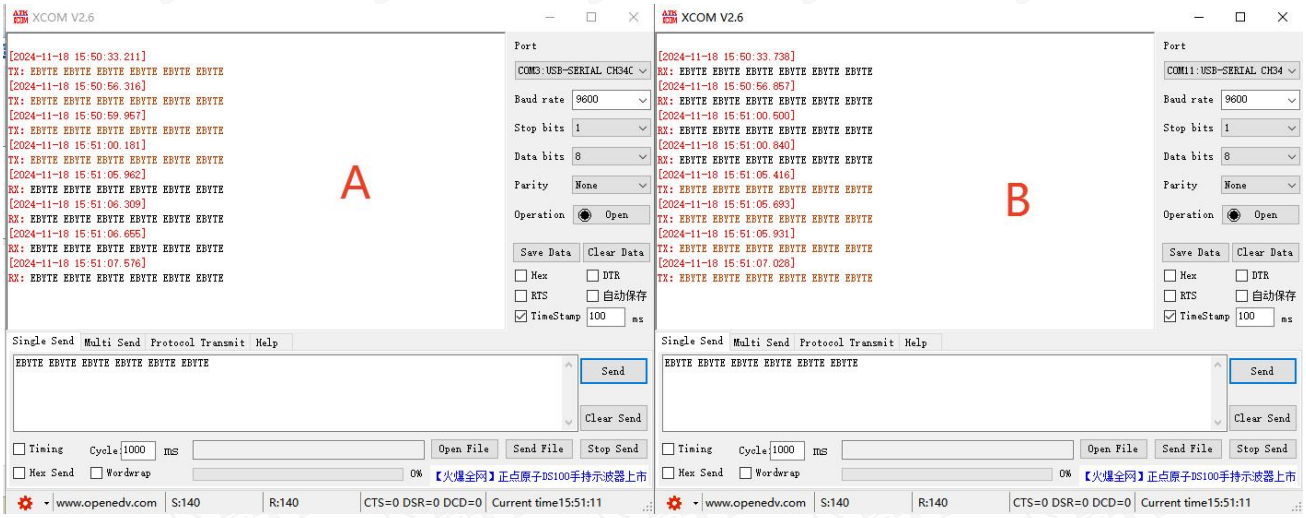
The module has four working modes, which are set by pins M1 and M0 . The details are shown in the following table:

Mode (0-3)	M1	M0	Mode Introduction	Remark
0 Transfer Mode	0	0	Serial port open, wireless open, transparent transmission	Support special command air configuration
1 WOR mode	0	1	Can be defined as WOR sender and WOR receiver	Support air wake-up
2 Configuration Mode	1	0	Users can access the registers through the serial port to control the working status of the module	
3 Deep Sleep	1	1	The module enters sleep mode	

Note: However, 62.5Kbps and 38.4Kbps are not recommended in WOR mode.

5.1.1 Transfer mode use (M1, M0 pins set to 0,0)

- **Transparent transmission function** : What you send is what you get. Use the serial port assistant to communicate with each other (the factory default parameters are consistent, and the transmission method is transparent transmission). The example is as follows:

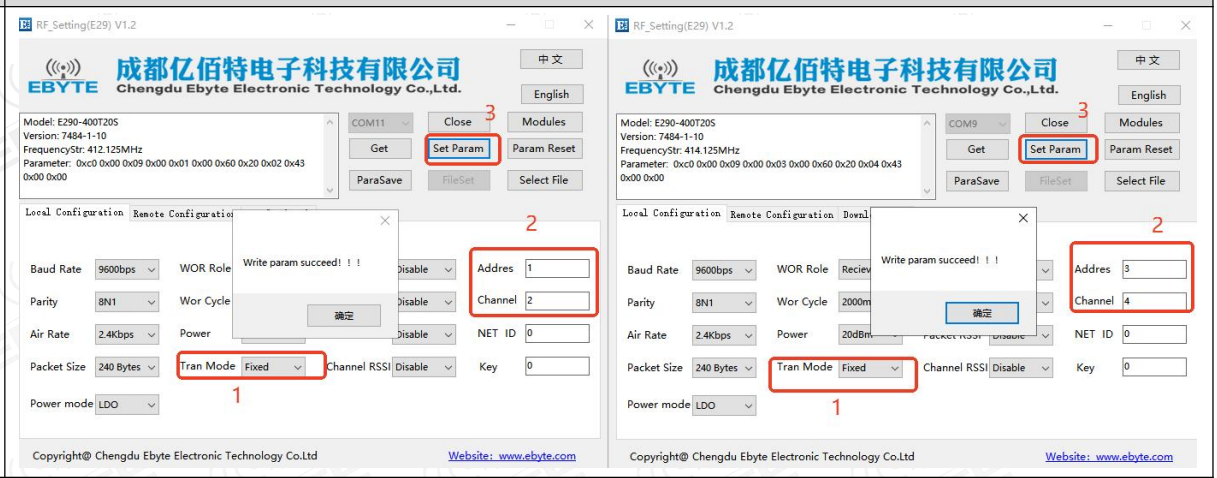
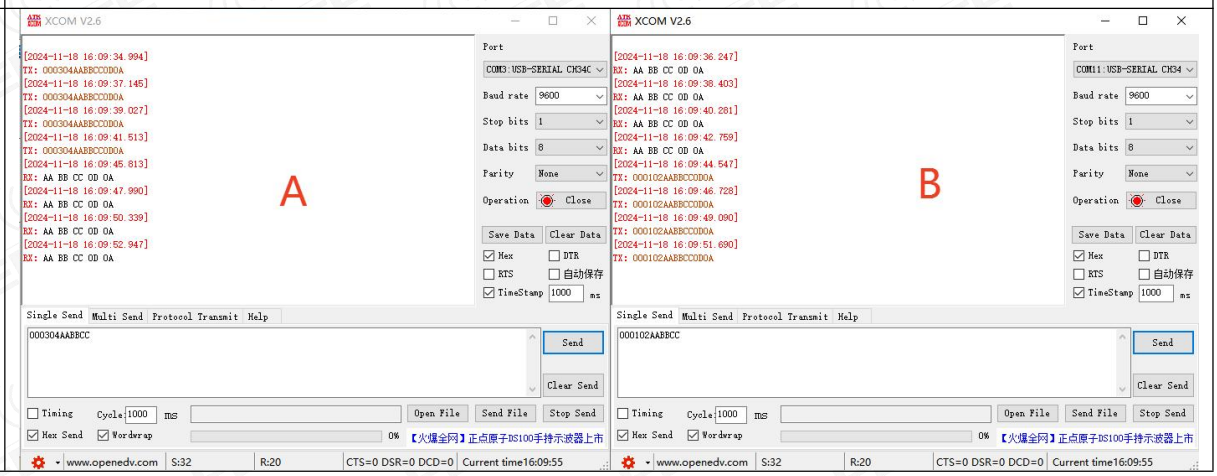


Schematic diagram

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- **Fixed-point transmission function:** Send and receive data in a fixed data format, the format is: target address + target channel + data, effectively avoiding partial interference.

Serial number	Steps for using fixed-point launch
1. Modify the parameters of the module through the host computer: modify the module address and channel under the configuration mode (M1, M0 pins are set to 1, 0) , change the transparent transmission mode to fixed - point transmission, and finally write the parameters to complete the modification .	
2. Change the module working mode to the general mode: edit the parameters of module A to 000304AABBCC and send it to module B. Similarly, the data sent by module B is 000102AABBCC. (The transmission data format in fixed-point mode is: target address + target channel + data)	

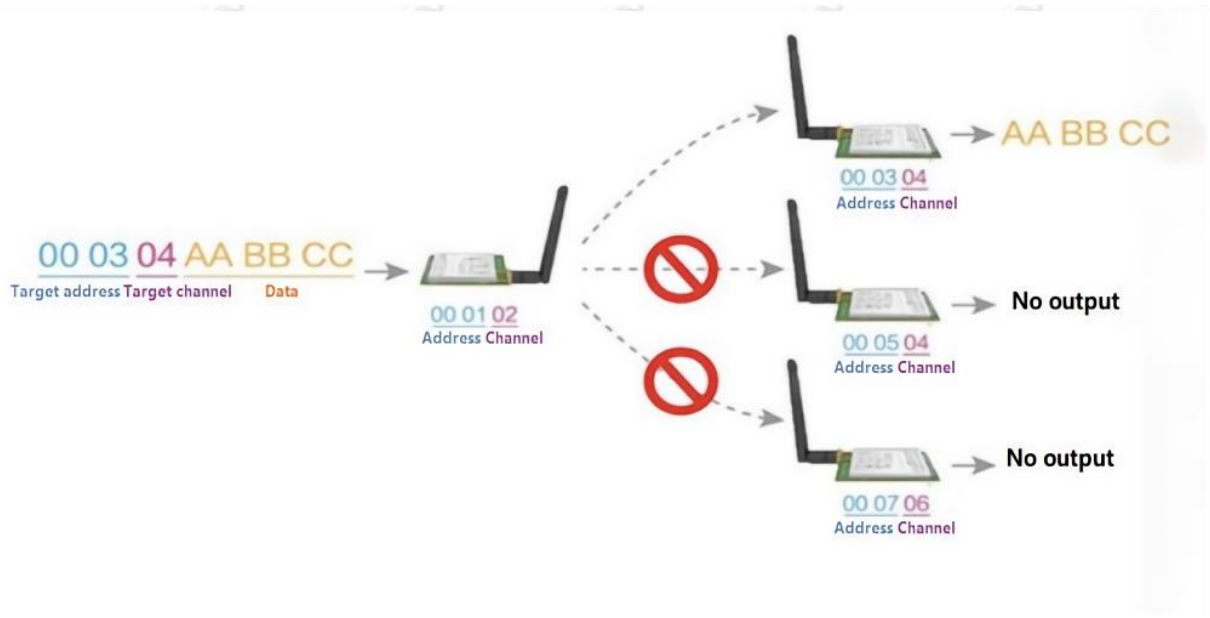


Figure 1 Schematic diagram of fixed-point transmission

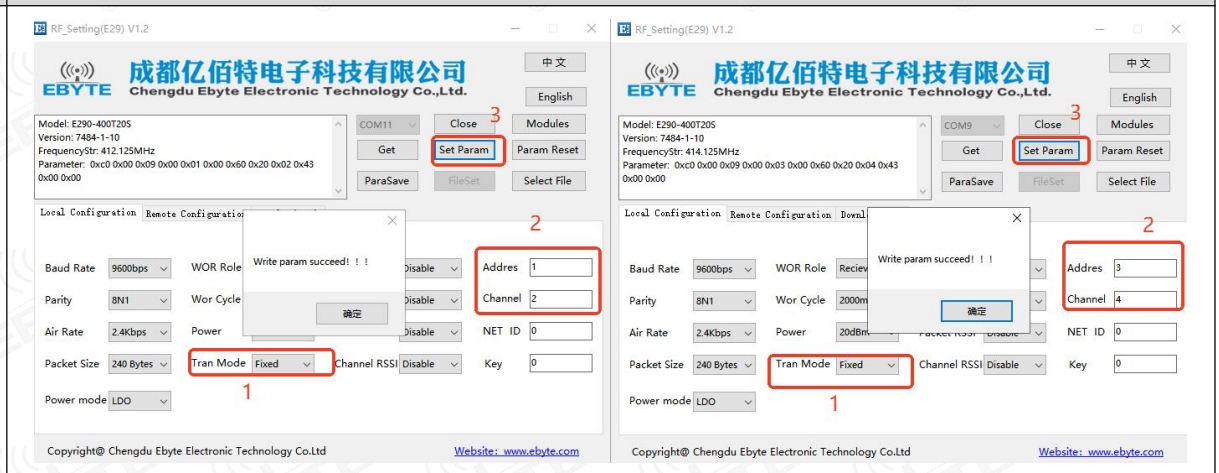
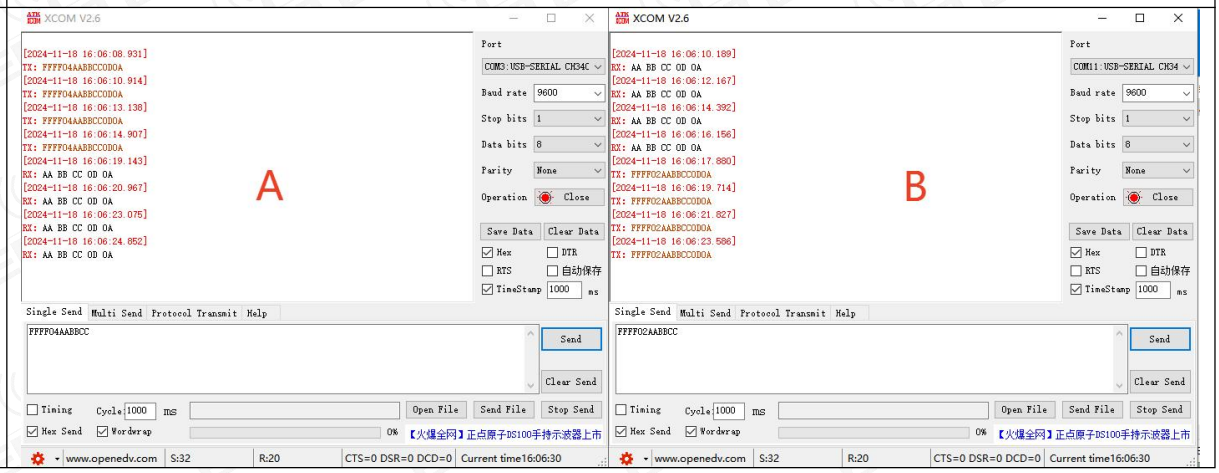
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- **Broadcasting function:**

1) Set the address of module A to 0xFFFF and the channel to 0x04 . When module A is used as a transmitter (same mode, transparent transmission or fixed-point transmission), all receiving modules under the 0x04 channel can receive data, achieving the purpose of broadcasting.

2) Set the address of module A to 0xFFFF and the channel to 0x04. When module A is used as a receiver, it can receive all the data under the 0x04 channel to achieve the purpose of monitoring.

Serial number	Steps for using fixed-point broadcast transmission
1. Modify the parameters of the module through the host computer: modify the module address and channel in the configuration mode (M1, M0 pins are set to 1, 0) , change the transparent transmission mode to fixed - point transmission, and finally write the parameters to complete the modification .	
2. Change the module working mode to the general mode: edit the parameters of module A to FFFF04AABBCC and send it to module B. Similarly, the data sent by module B is FFFF02AABBCC. (The data transmission format in fixed-point broadcast mode is: broadcast address + target channel + data)	

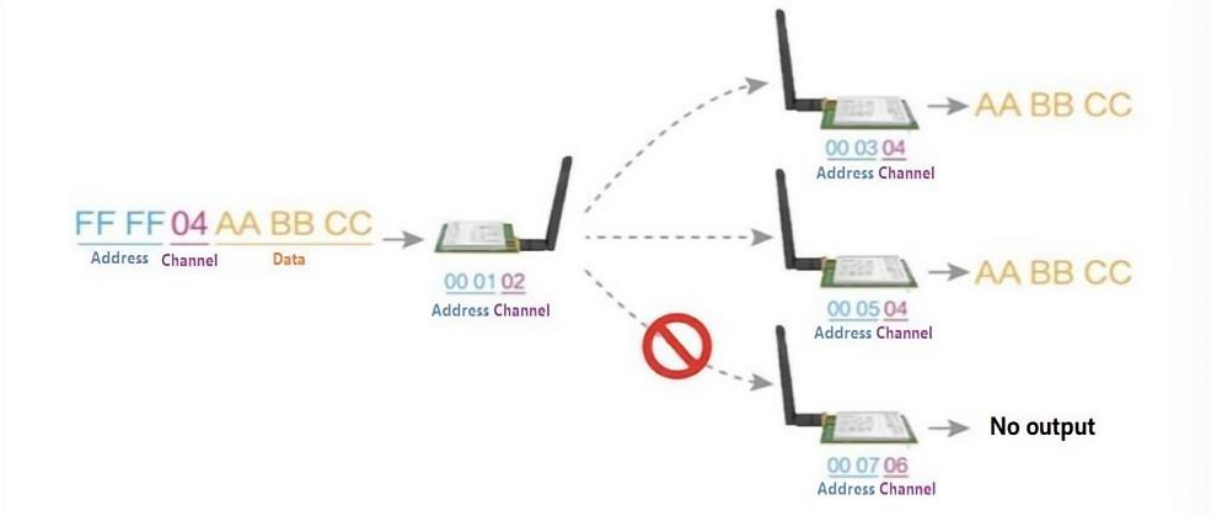


Figure 2 Schematic diagram of fixed-point broadcast transmission

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- **Relay networking mode:** Relay networking forwards data between source nodes and target nodes through relay nodes, thereby expanding network coverage and improving communication reliability.

Serial number	Relay Mode Description
1	After setting the relay mode through the configuration mode, switch to the general mode and the relay starts working.
2	In relay mode, ADDH and ADDL are no longer used as module addresses, but are forwarded and paired with NETID respectively. If a signal is received from one network, it will be forwarded to the other network . The repeater's own network ID is invalid.
3	In the relay mode, the relay module cannot send and receive data and cannot perform low-power operation.
4	When the user enters other modes from mode 3 (sleep mode) or during the reset process, the module will reset the user parameters, during which AUX outputs a low level.

Relay networking rules:

1、Forwarding rules, the relay can forward data bidirectionally between two NETIDs.

2、In relay mode, ADDH\ADDL is no longer used as the module address, but as NETID for forwarding pairing.

As shown in the figure:

①First -level relay

"Node 1" NETID is 08.

"Node 2" NETID is 33.

The ADDH\ADDL of relay 1 are 08 and 33 respectively.

So the signal sent by node 1 (08) can be forwarded to node 2 (33)

At the same time, the addresses of node 1 and node 2 are the same, so the data sent by node 1 can be received by node 2.

② Secondary relay

The ADDH\ADDL of relay 2 are 33, 05 respectively.

So relay 2 can forward the data of relay 1 to network NETID:05.

Therefore, nodes 3 and 4 can receive data from node 1. Node 4 outputs data normally, but node 3 does not output data because its address is different from that of node 1.

③Two -way relay

As shown in the configuration figure: the data sent by node 1 can be received by nodes 2 and 4, and the data sent by nodes 2 and 4 can also be received by node 1.

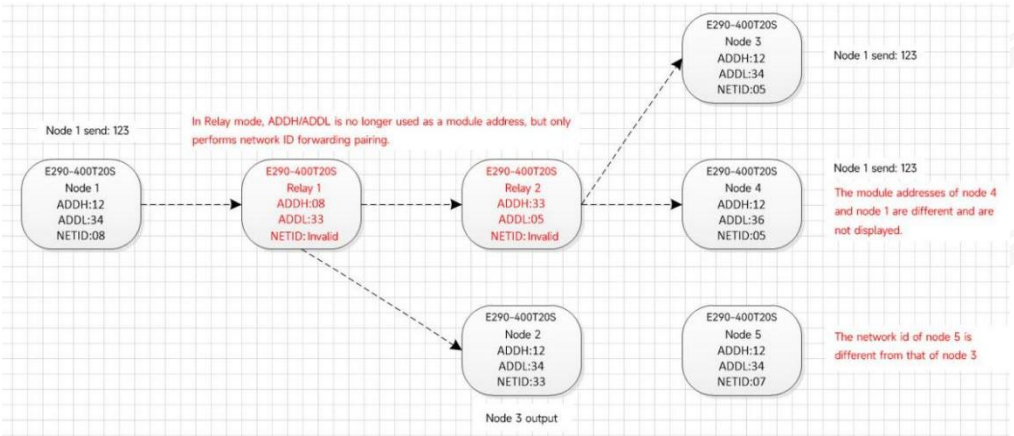
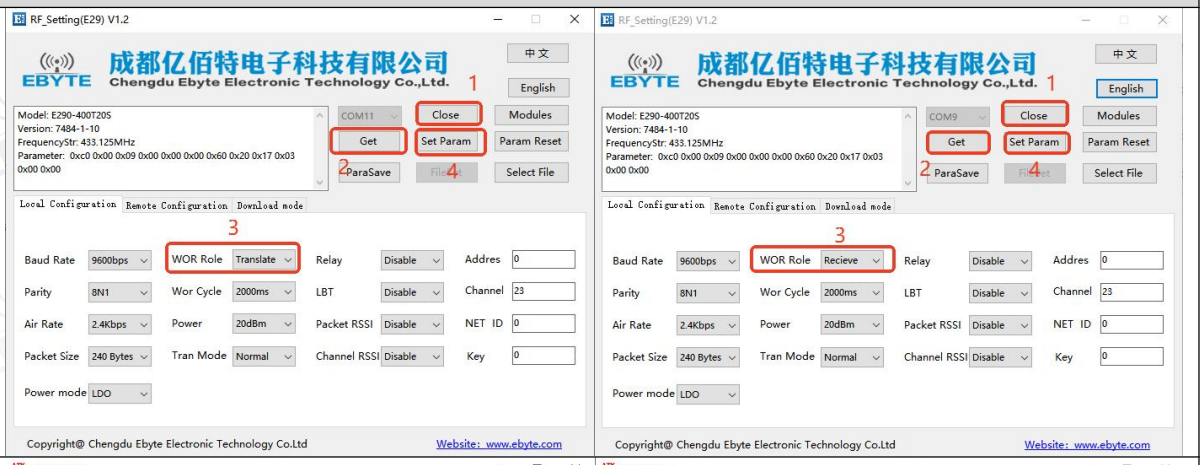
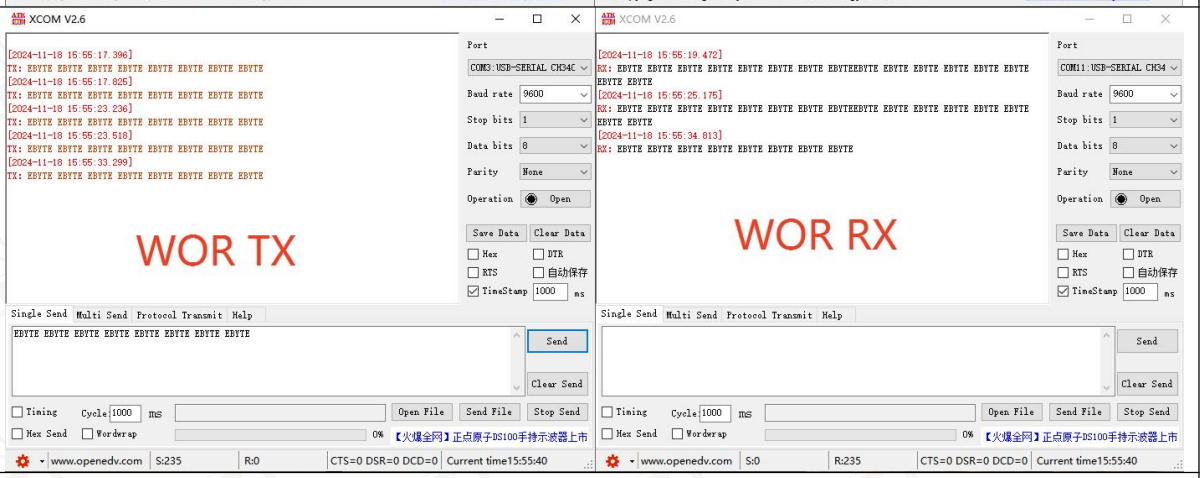


Figure 3 Example of relay mode

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5.1.2 WOR mode use (M1, M0 pins set to 0,1)

Serial number	Steps to use WOR mode
1. Modify the parameters of the module through the host computer: modify the module WOR role in the configuration mode (M1, M0 pins are set to 1, 0), and write the parameters to complete the modification .	
2. The module working mode is changed to WOR mode (M1, M0 pins are set to 0, 1): The WOR receiver module sends data to the WOR receiver module, but the WOR receiver module cannot send data to the sender.	

Note: In WOR mode, the single-point wake-up function supports only addresses 0-900 at airspeeds of 38.4K and below, and the use of 38.4K and 62.5K airspeeds is not recommended.

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5.1.3 Configuration mode use (M1, M0 pins set to 1, 0)

1) The following figure shows the upper computer display interface of the module configuration. Users can switch to command mode through M0 and M1 to quickly configure and read parameters on the upper computer.



2) In the configuration host computer, the module address, frequency channel, network ID, and key are all displayed in decimal mode; the value range of each parameter is:

Network address: 0-65535 (Note: In WOR mode, the single point wake function only supports 0-900 addresses at 38.4K airspeed and below.)

Frequency channel: 0~83(Note: the 900 MHz band channel range is from 0 to 80)

Network ID: 0-255

Key: 0-65535

3) When users use the host computer to configure the relay mode, they need to pay special attention to the fact that since the parameters in the host computer are displayed in decimal mode, the module address and network ID need to be converted when filling in the decimal system.

If the network ID input by the transmitter A is 02 and the network ID input by the receiver B is 10, when the relay R sets the module address, the hexadecimal value 0X020A is converted to the decimal value 522 as the module address filled in by the relay R;

That is, the module address value that needs to be filled in at the relay end R is 522.

4) Remote configuration : Remotely read and modify module parameters through the host computer: Module A and module B must have the same parameters to perform remote configuration . For example: Module A is in configuration mode, and module B is in general mode. Module A can use the host computer to open remote configuration and read parameters.

5.1.4 Sleep mode use (M1, M0 pins set to 1,1)

- **To enter sleep mode, just set the M1 and M0 pins to 1, 1.**

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5.2 Module reset

- the module is reset , AUX will output a low level, perform hardware self-test, and set the working mode according to user parameters;

  During this process, AUX maintains a low level. After completion, AUX outputs a high level and starts working normally according to the working mode composed of M1 and M0.

  Therefore, the user needs to wait for the AUX rising edge as the starting point for the module to work normally.

5.3 Single point wake-up

- The following measurement parameters are all default parameters, only the address and WOR role are changed
- E290-xxxTxxS supports single-point wake-up function, which can wake up a module alone without waking up all modules. The current consumption diagram of the receiving device when it is the target device is shown in Figure 1 below , and the other non-target devices will re-enter the sleep state as shown in Figure 2.
- The E290-xxxTxxS can also partially sleep while receiving a wake-up code, further reducing power consumption.
- Note: When the airspeed is 62.5K and 38.4K, this single point wake-up function is temporarily unavailable and can only be used in traditional WOR mode.

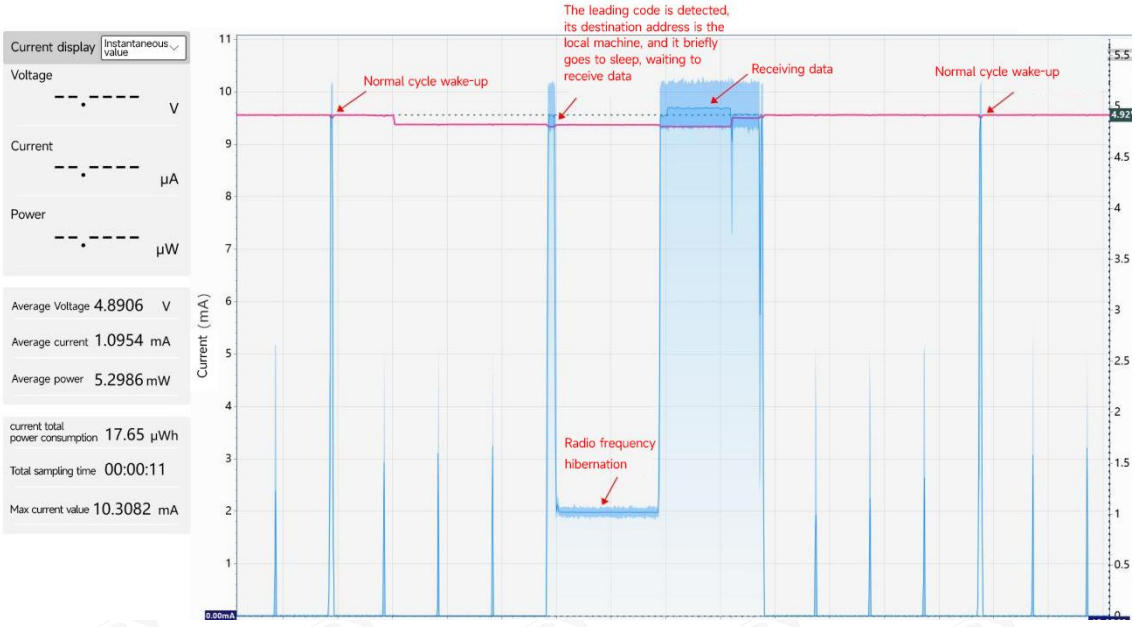


Figure 1 Target device current consumption diagram

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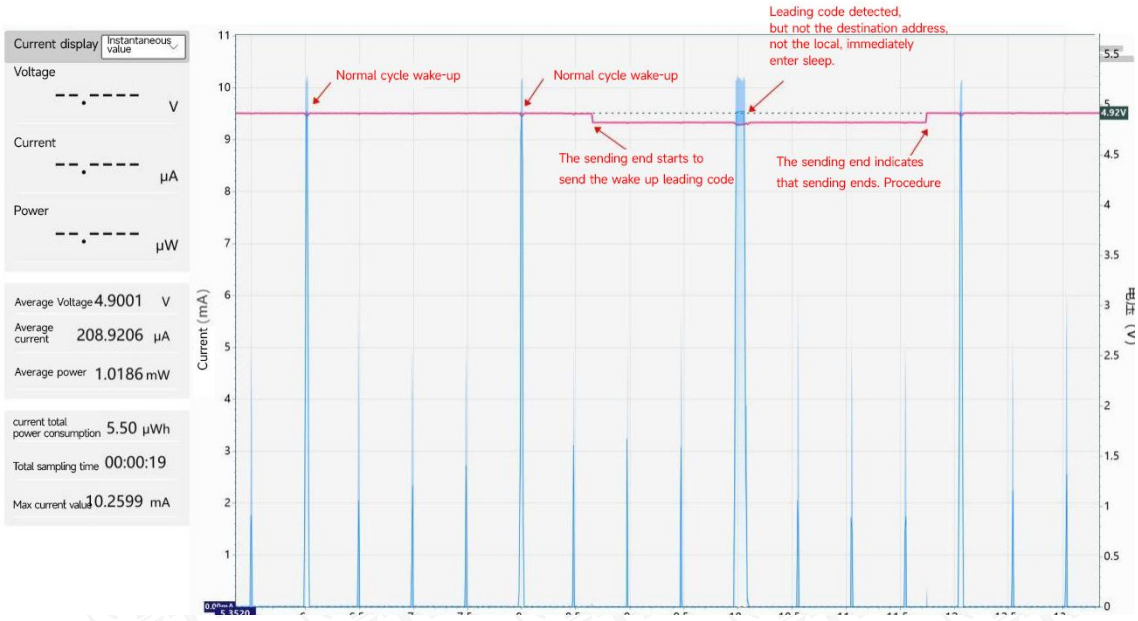


Figure 2 Current consumption of non-target devices

- In addition, the E290-xxxTxxS cannot actively send data via RF by default in WOR receiving mode. In order to solve the problem that users repeatedly switch between WOR receiving mode and transparent transmission mode in the polling structure to achieve response , the E290-xxxTxxS can enable this function by setting C0 09 02 E8 03 or AT+DELAY=1000. After enabling this function, users can send wireless data via UART within 1000 ms after receiving data in WOR receiving mode.
- HEX instruction (C0 09 02 E8 03): C0 is the write command, 09 is the register start address, 02 is the length, 0x03E8 is the set delay, the maximum value 0xFFFF is 65535ms, and setting it to 0 will turn off the wake-up delay.

5. 4 AUX Detailed Explanation

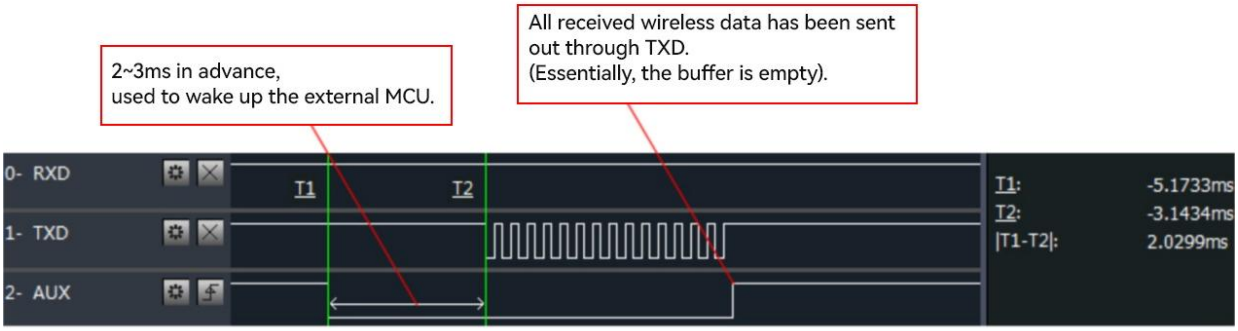
- AUX is used for wireless transceiver buffer indication and self-test indication.
- It indicates whether the module has data that has not been transmitted wirelessly, or whether the received wireless data has not been sent out through the serial port, or the module is in the process of initializing self-test.
- AUX cannot be low at the moment of power-on, otherwise it will be forced into firmware upgrade mode.

5.4.1 Serial port data output indication

- Used to wake up the external MCU in sleep mode;

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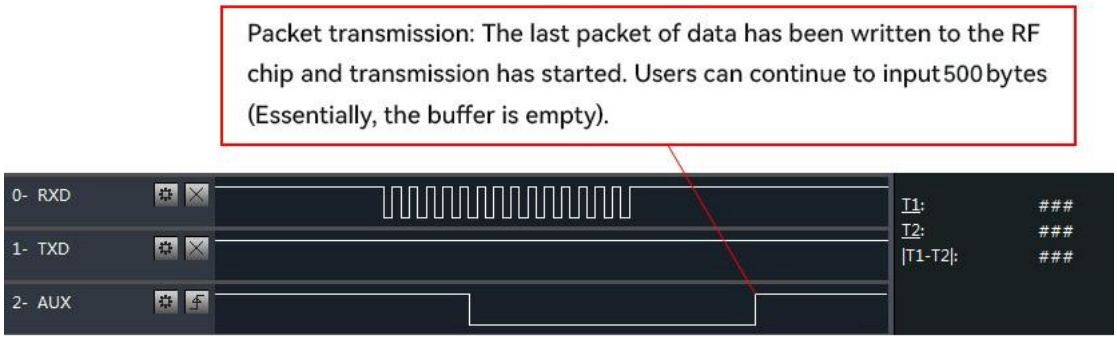
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AUX pin timing diagram when module serial port sends out data.

5.4.2 Wireless transmission indication

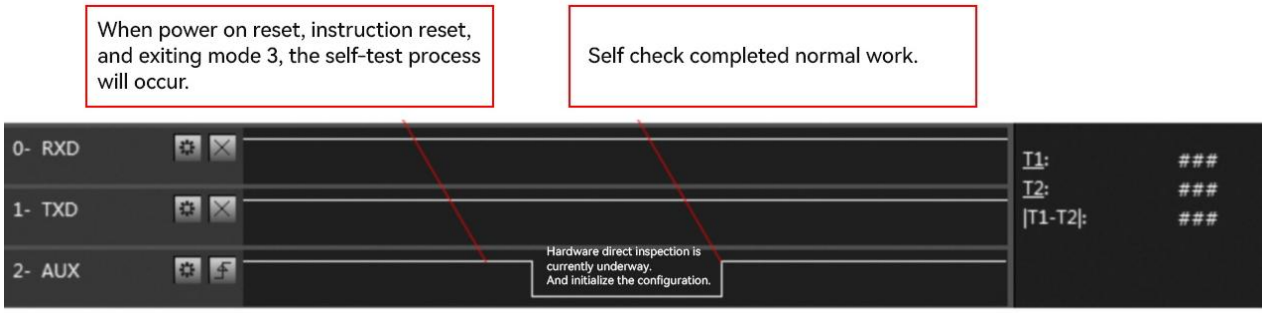
- Buffer empty: data in the internal 500- byte buffer are all written to the wireless chip (automatically divided into packets) ;
  When AUX=1, the user can continuously send data less than 500 bytes without overflow ;
  When AUX=0, the buffer is not empty: the data in the internal 500 -byte buffer has not been fully written to the wireless chip and the transmission has not yet started. At this time, the module may have timed out waiting for the end of user data, or is transmitting wireless packets .



AUX pin timing diagram when the module receives serial port data.

5.4.3 The module is being configured

- Only when resetting and exiting sleep mode;



During self check, AUX pin timing diagram.

5.4.4Precautions

Serial numbe	AUX Notes

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r	
1	For the above functions 1 and 2, the output low level is given priority, that is, if any output low level condition is met, AUX will output low level; When all low-level conditions are not met, AUX outputs a high level.
2	When AUX outputs a low level, it means the module is busy and no working mode detection will be performed at this time; When the module AUX outputs a high level within 1ms, the mode switching will be completed.
3	After the user switches to a new working mode, the module will not actually enter this mode until at least 2ms after the AUX rising edge. If AUX is always at a high level, the mode switch will take effect immediately.
4	When the user enters other modes from mode 3 (sleep mode) or during the reset process, the module will reset the user parameters, during which AUX outputs a low level.
5	Due to the characteristics of ChirpIoT™ modulation, the information transmission delay is much longer than FSK. For example , at an airspeed of 2.4 kbps, the transmission delay of 100 bytes is about 1 second . Customers are advised not to transmit large amounts of data at low airspeeds to avoid data loss due to data accumulation and cause communication abnormalities.

6 Register Read and Write Control

6.1 Instruction format

configuration mode (mode 2: M1=1, M0=0), the supported command list is as follows (**when setting, only 9600, 8N1 format is supported**):

Serial number	Instruction Format	Detailed description
1	Setting Registers	Instruction: C0+starting address+length+parameter Response: C1+starting address+length+parameters Example 1: Restore factory default parameters Instruction start address length parameter Send: C0 00 09 00 00 00 60 20 17 03 00 00 Return: C1 00 09 00 00 00 60 20 17 03 00 00 Example 2: Configure the module address (0x1234), network address (0x00), serial port (9600 8N1), and airspeed (2.4 K) at the same time Send: C0 00 04 12 34 00 60 Return: C1 00 04 12 34 00 60
2	Read Register	Instruction: C1+starting address+length Response: C1+starting address+length+parameters Example 1: Read all setting parameters Instruction start address length parameter Send: C1 00 09 Return: C1 00 09 00 00 00 60 20 17 03 00 00 Example 2: Read module address, network address, serial port, and airspeed simultaneously Send: C1 00 04 Return: C1 00 04 12 34 00 60
3	Setting up temporary registers	Instruction: C2 + starting address + length + parameter Response: C1 + start address + length + parameter Example 1: Configure the channel to 0x09 Instruction start address length parameter Send: C2 05 01 09 Return: C1 05 01 09

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		Example 2: Configure the module address (0x1234), network address (0x00), serial port (9600 8N1), and airspeed (2.4 K) at the same time Send: C2 00 04 12 34 00 60 Return: C1 00 04 12 34 00 60
4	Wireless Configuration	Instruction: CF CF + regular instruction Response: CF CF + normal response Example 1: The wireless configuration channel is 0x09 Wireless command header command start address length parameter Send: CF CF C0 05 01 09 Return: CF CF C1 05 01 09 Example 2: Wirelessly configure the module address (0x1234), network address (0x00), serial port (9600 8N1), and airspeed (2.4 K) at the same time Send: CF CF C0 00 04 12 34 00 60 Return: CF CF C1 00 04 12 34 00 60
5	Format Error	Format Error Response FF FF FF / " =ERR "

6.2 Register Description

<table>
<tr><th>Serial number</th><th>Read and Write</th><th>name</th><th colspan="5">describe</th><th>Remark</th></tr>
<tr><td>00H</td><td>Read/ Write</td><td>ADDH</td><td colspan="5">ADDH (default 0)</td><td rowspan="2">The high byte and low byte of the module address . When the module address is equal to FFFF, it can be used as a broadcast and monitoring address.</td></tr>
<tr><td>01H</td><td>Read/ Write</td><td>ADDL</td><td colspan="5">ADDL (default 0)</td></tr>
<tr><td>02H</td><td>Read/ Write</td><td>NETID</td><td colspan="5">NETID (default 0)</td><td>Network address, used to distinguish networks ; When communicating with each other, they should be set to the same.</td></tr>
<tr><td rowspan="11">03H</td><td rowspan="11">Read/ Write</td><td rowspan="11">REG0</td><td>7</td><td>6</td><td>5</td><td>UART serial port rate (bps)</td><td rowspan="11">The two modules that communicate with each other can have different serial port baud rates and verification methods ;
When transmitting large data packets continuously, users need to consider data blocking or even data loss caused by the same baud rate ;
It is generally recommended that both parties in communication have the same baud rate.</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>The serial port baud rate is 1200</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>The serial port baud rate is 2400</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>The serial port baud rate is 4800</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>The serial port baud rate is 9600 (default)</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>The serial port baud rate is 19200</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>The serial port baud rate is 38400</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>The serial port baud rate is 57600</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>The serial port baud rate is 115200</td></tr>
<tr><td>4</td><td>3</td><td colspan="3">Serial port check digit</td><td rowspan="2">The serial port modes of the two communicating parties can be different ;</td></tr>
<tr><td>0</td><td>0</td><td colspan="3">8 N1 (default)</td></tr>
</table>

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			0	1	8 O1		
			1	0	8 E1		
			1	1	8 N1 (equivalent to 0 0)		
			2	1	0	Wireless air rate (bps)	The air rate of both communicating parties must be the same ; air rate, the smaller the delay and the shorter the transmission distance. 0~2: BW = 250K 3~7: BW = 500K
			0	0	0	Air rate 2.4k (default)	
			0	0	1	Air speed 2.4k	
			0	1	0	Air speed 2.4k	
			0	1	1	Air speed 4.8 k	
			1	0	0	Air speed 9.6 k	
			1	0	1	Air speed 19.2 k	
			1	1	0	Air speed 38.4 k	
			1	1	1	Air speed 62.5 k	
04H	Read/ Write	REG1	7	6	Subcontracting settings		The data sent by the user is smaller than the packet length, and the serial port output at the receiving end appears as uninterrupted continuous output ; If the data sent by the user is larger than the packet length, the receiving serial port will output it in packets.
			0	0	2 40 bytes (default)		
			0	1	1 28 bytes		
			1	0	6 4 bytes		
			1	1	3 2 bytes		
			5	RF Power Mode			Users can change the RF power mode according to their needs: 1、DCDC mode reduces power consumption by sacrificing sensitivity 2、LDO mode improves sensitivity at the expense of power consumption 3. DCDC mode can be used for battery-powered devices
			0	DCDC mode			
			1	LDO mode (default)			
			4	RSSI environment noise enable			When enabled, you can send commands in transfer mode or WOR send mode. Let C0 C1 C2 C3 instruction read register; Register 0x00: Current ambient noise RSSI; Register 0X01: RSSI when receiving data last time (The current channel noise is: dBm = -(256 - RSSI)); Instruction format: C0 C1 C2 C3 + starting address + read length; Return: C1 + address + read length + read valid value; such as: Send C0 C1 C2 C3 00 01 Return C1 00 01 RSSI (address can only start from 00
			0	Disabled (default)			
			1	Enable			
			3	2	reserve		The relationship between power and current is nonlinear. When the power is at maximum, the power efficiency is the highest . The current does not decrease in the same proportion as the power decreases.
			1	0	Transmit power		
			0	0	20dBm / 30dBm (default)		
			0	1	18dBm / 28dBm		
			1	0	14dBm / 24dBm		

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			1	1	10dBm / 20dBm	
05H	Read/ Write	REG2	Channel control (CH) 0-83 represent a total of 8 4 channels (corresponding to the 410.125 ~ 493.125MHz frequency band) 0-8 0 represents a total of 8 1 channels (corresponding to the 850.125 ~ 930.125MHz frequency band)			Actual frequency = 410.125 + CH * 1M Actual frequency = 850.125 + CH* 1M
06H	Read/ Write	REG3	7	Enable RSSI Byte		After enabling, the module receives wireless data and outputs it through the serial port TXD, followed by an RSSI strength byte.
			0	Disabled (default)		
			1	Enable		
			6	Transmission method		During fixed-point transmission, the module will recognize the first three bytes of the serial port data as: address high + address low + channel, and use it as the wireless transmission target.
			0	Transparent transmission (default)		
			1	Fixed-point transmission		
			5	Relay function		After the relay function is enabled, if the destination address is not the module itself, the module will initiate a forwarding ; To prevent data from being transmitted back, it is recommended to use it in conjunction with fixed-point mode ; that is, the target address and source address are different.
			0	Disable relay functionality (default)		
			1	Enable relay function		
			4	LBT (Listen Before Send)		After enabling, the wireless data will be intercepted before transmitting, which can avoid interference to a certain extent, but may cause data delay; the maximum dwell time of LBT is 2 seconds, and it will be forced to send after reaching the time limit.
			0	Disable LBT (default)		
			1	Enable LBT		
			3	WOR mode transceiver control		Only valid for mode 1; 1. In the WOR receiving mode, the module can modify the delay time after wake-up, the default time is 0; 2. The receiving end needs to send the command C0 09 02 E8 in configuration mode 03 (C0 is the write command, 09 is the register start address, 02 is the length, 0x 03E8 is the set delay, the maximum FFFF is 65535ms, and setting it to 0 turns off the wake-up delay.) 3. Data can be sent within the delay
			0	WOR Receiver (Default) Working in WOR monitoring mode, the monitoring cycle is shown below (WOR cycle), which can save a lot of power consumption.		
			1	WOR transmitter The module is turned on for transmission and reception, and a wake-up code is added for a certain period of time when transmitting data.		
			2	1	0	W OR Cycle
			0	0	0	500 ms
			0	0	1	1000ms
			0	1	0	1500ms
			0	1	1	2000ms
			1	0	0	2500ms
			1	0	1	3000ms
			1	1	0	3500ms
			1	1	1	4000ms
07H	Write	CRYPT _H	Key high byte (default 0)			Write only, read returns 0 ; Used for encryption to prevent wireless data from being intercepted by similar modules ; The module will use these two bytes as calculation factors to transform and encrypt the wireless signal in the air.
08H	Write	CRYPT _L	Key low byte (default 0)			

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6.3 Heartbeat packet function configuration

configuration mode (mode 2: M1=1, M0=0), the supported command list is as follows (**when setting, only 9600, 8N1 format is supported**):

NO.	Instruction Format	Detailed description
1	Configuration directives	Instruction: C 5 + starting address + length + parameter Configuration command: C5 + 00 + 01 + 00 **Instruction structure meaning:** ● **C5** : Command header ● **00** : Register address (00: Heartbeat packet function selection register ; 01: Heartbeat packet custom cycle time configuration register ; 02: Heartbeat packet custom data configuration . ● **01** : Register data length (the heartbeat packet function selection register data length is 1 byte, the heartbeat packet custom cycle time configuration register data length is 2 bytes, and the heartbeat packet custom data configuration length is up to 128 bytes .) ● **00** : Register data
2	Register Function Description	**00 register data meaning :** ● Configuration parameter 00: Disable the heartbeat packet function. ● Configuration parameter 01: Output periodic heartbeat packet data through the serial port. ● Configuration parameter is 02: Heartbeat packet data (send address, channel, network ID) is sent wirelessly. ● Configuration parameter is 03: The heartbeat packet data is sent through the wireless fixed-point (the parameters of the network ID module itself, the sending address and channel depend on the first three bytes of the customized heartbeat packet data: 2-byte address + 1-byte channel, followed by the heartbeat wireless transmission data).
3	Example	**01 Register:** The register configuration parameter is two bytes, which configures the cycle time of the heartbeat packet. For example: C5 01 02 00 05 configures the time to 5s **02 Register:** Customize heartbeat packet parameter configuration For example: C5 02 05 11 22 33 44 55 Configure the heartbeat packet return data to be : 11 22 33 44 55 **Read instruction:** C6 00 01 C6: Command Header 00: Register address 01: Length of the register data read
4	Format Error	Format Error Response FF FF FF / " =ERR "

6.4 Factory default parameters

Model	E290-400T20S, E290-400T30S factory default parameter value: C0 00 09 00 00 00 6 0 2 0 17 03 00 00 E290-900T20S factory default parameter value: C0 00 09 00 00 00 6 0 2 0 12 03 00 00						
Module Model	frequency	address	Channel	Air speed	Baud rate	Serial port format	Transmit power
E290-400T20S	433.125MHz	0x0000	0x17	2.4kbps	9600	8N1	20dbm

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E290-400T30S	433.125MHz	0x0000	0x17	2.4kbps	9600	8N1	30dbm
E290-900T20S	868.125MHz	0x0000	0x12	2.4kbps	9600	8N1	20dbm

7 AT Commands

AT commands are used in configuration mode. AT commands are divided into three categories: command commands, setting commands and query commands;

Users can query the AT command set supported by the module through "AT+HELP=?". The baud rate used by AT commands is 9600 8N1.

When the input parameter exceeds the range, an error message will be returned.

Note: AT commands do not require carriage return and line feed (\r\n).

7.1 AT command table

Command Instructions	describe	Example	Example Description
AT+IAP (Use with caution)	Enter IAP upgrade mode	AT+IAP	Enter IAP upgrade mode
AT+RESET	Device restart	AT+RESET	Device restart
AT+DEFAULT	Restore Default Settings	AT+DEFAULT	Restore Default Settings

Setting Instructions	describe	Example	Example Description
AT+UART=baud,parity	Set baud rate and parity	AT+UART=3,0	Set the baud rate to 9600, 8N 1
AT+RATE=rate	Set air speed	AT+RATE=7	Set the air speed to 62.5 K
AT+PACKET=packet	Set packet length	AT+PACKET=0	Set the packet size to 240 bytes
AT+WOR=role,period	Set WOR roles and cycles	AT+WOR=0,3	Set to WOR reception, period is 2000ms
AT+POWER=power	Set the transmit power	AT+POWER=0	Set the transmit power to 20 dBm / 30 dBm
AT+TRANS=mode	Set the sending mode	AT+TRANS=1	Set to fixed point mode
AT+ROUTER=router	Set Repeater Mode	AT+ROUTER=1	Set to Repeater Mode
AT+DRSSI=data_rssi	Setting data RSSI output function	AT+DRSSI=1	Receive data RSSI function is enabled
AT+ERSSI =env_rssi	Setting the environment RSSI reading function	AT+ERSSI=1	The ambient RSSI reading function is enabled
AT+LBT=lbt	Setting the channel monitoring function	AT+LBT=1	Channel monitoring function is enabled
AT+LDO=ldo	Set LDO power mode switch	AT+LDO=1	Set the RF to LDO mode
AT+ADDR=addr	Set module address	AT+ADDR=1234	Set the module address to 1234
AT+CHANNEL=channel	Set the module working channel	AT+CHANNEL=23	Set the frequency to 433.125M /868.125MHz
AT+NETID=netid	Set Network ID	AT+NETID=2	Set the network ID to 2

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AT+KEY=key	Set module key	AT+KEY=1234	Set the module key to 1234
AT+DELAY=delay	Set the wake-up delay sleep time , and the single-point wake-up mode can restore data within the time.	AT+DELAY=1000	Set the wake-up delay sleep time to 1000ms , and the single-point wake-up mode can restore data within the time.
AT+SEARCH=search	Setting the airspeed adaptation function (The airspeed of both parties cannot be 2.4K)	AT+SEARCH=search	Turn on the airspeed adaptive function. Communication is possible even if the airspeed is not 2.4K

Query command	describe	Return to example	Example Description
AT+HELP=?	Query AT command table		Return to AT command table
AT+DEVTYPE=?	Query module model	DEVTYPE=E290-xxxTxxS/D	Return module model
AT+FWCODE=?	Query firmware code	FWCODE=7484 -0-10	Returns the firmware version
AT+UART=?	Query baud rate and checksum	AT+UART=3,0	return baud rate is 9600, 8N 1
AT+RATE=?	Query air speed	AT+RATE= 0	return air speed is 2.4 K
AT+PACKET=?	Query packet length	AT+PACKET=0	return packet is 240 bytes
AT+WOR=?	Query WOR roles and cycles	AT+WOR=0, 1	The return is WOR reception, the cycle is 1 000ms
AT+POWER=?	Query the transmit power	AT+POWER=0	Return transmit power is 20 dBm / 30 dBm
AT+TRANS=?	Query sending mode	AT+TRANS=1	Return to fixed-point mode
AT+ROUTER=?	Query relay mode	AT+ROUTER=1	Return to relay mode
AT+DRSSI=?	Query RSSI data output enable	AT+DRSSI=1	Data RSSI function enable
AT+ERSSI =?	Query and read RSSI function enable	AT+ERSSI=1	RSSI reading function enabled
AT+LBT=?	Query whether the channel monitoring function is enabled	AT+LBT=1	Channel monitoring function enabled
AT+LDO=?	Query the RF power mode status	AT+LDO=0	RF works in DCDC mode
AT+ADDR=?	Query module address	AT+ADDR=1234	returned module address is 1234
AT+CHANNEL=?	Query module working channel	AT+CHANNEL=23	return frequency is 433.125M /868.125MHz
AT+NETID=?	Query Network ID	AT+NETID=2	returned network ID is 2
AT+KEY=?	Query module key	AT+KEY= 0 (cannot read)	Returns the module key as 0
AT+DELAY=?	Query WOR delayed sleep time	AT+DELAY=1000	Return WOR delay sleep time is 1000ms
AT+SEARCH= ?	Query airspeed adaptation	AT+SEARCH=1	Return airspeed adaptation is on
AT+UID=?	Query unique serial number	AT+UID=xx	Returns the unique serial number xx

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7.2 AT parameter analysis

When the serial port receives the correct command, the serial port will return "Command = OK", otherwise it will return "=ERR"

Command parameters	Parameter meaning
Baud (serial port baud rate)	0:1200 1:2400 2:4800 3:9600 4:19200 5:38400 6 : 57600 7:115200
Parity (serial port check bit)	0:8N1 1:8O1 2:8E1 3:8N1
Rate	0:2.4K 1:2.4K 2:2.4K 3: 4.8K 4:9.8K 5:19.2 K 6:38 .4K 7:62.5 K
Packet (packet length)	0: 240 1: 128 2: 64 3: 32
Role	0: Receive 1: Send
Period	0: 500 ms 1: 1000 ms 2: 1500 ms 3: 2000 ms 4: 2500 ms 5: 3000 ms 6 :3500 ms 7: 4000 ms
Power (transmit power)	0: 20dBm 1: 18dBm 2: 14dBm 3: 10dBm
Mode (Transmission Mode)	0: Transparent 1: Fixed point
Router (Relay Mode)	0: Off 1: Enable
Data_rssi (Data RSSI)	0: Off 1: Enable
Env_rssi (Environmental RSSI)	0: Off 1: Enable
Lbt (channel listening)	0: Off 1: Enable
Ldo (LDO mode switch)	0: DCDC 1: LDO
Addr (module address)	Module address 0~65535 (decimal)
Channel (module channel)	Module channel 0~83 (decimal)
Netid (Network ID)	Module network 0~255 (decimal)
Key	Module key 0~65535 (decimal)
Delay (WOR delay sleep)	Delay sleep 0~65535 (decimal)
Search (airspeed adaptation)	0: Disable 1: Enable

7.3 IAP Upgrade

If the customer needs to upgrade the firmware, he needs to find the corresponding BIN file provided by the official, and then use the official host computer to upgrade the firmware. Under normal circumstances, users do not need to upgrade the firmware, and please do not use the "AT+IAP" command .

The pins necessary for upgrading must be brought out (M1, M0, AUX, TXD, RXD, VCC, GND), and then send the "AT+IAP" command in the configuration mode to enter the upgrade mode. If you need to exit the IAP upgrade mode, you need to keep the power on and wait for 60 seconds, the program will automatically exit, otherwise it will enter the firmware upgrade mode indefinitely even if you restart.

After entering the upgrade mode, the baud rate will automatically switch to 115200 until it automatically exits, during which time there will be log output.

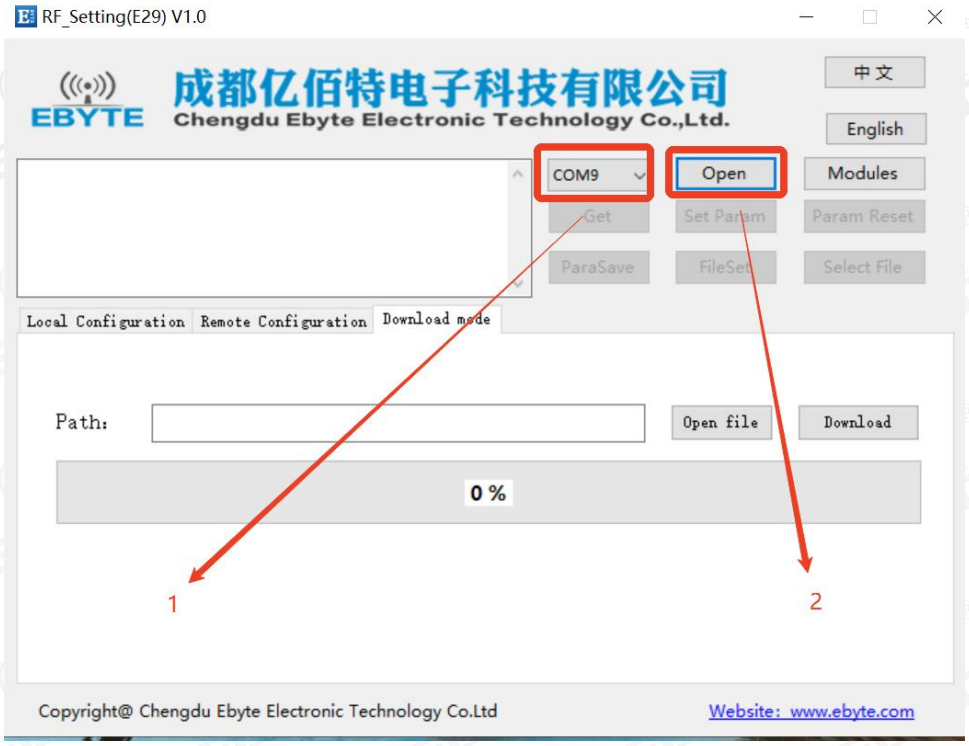
If AUX is pulled low before power-on, it will also force the software to enter the firmware upgrade mode to avoid failure in the upgrade mode.

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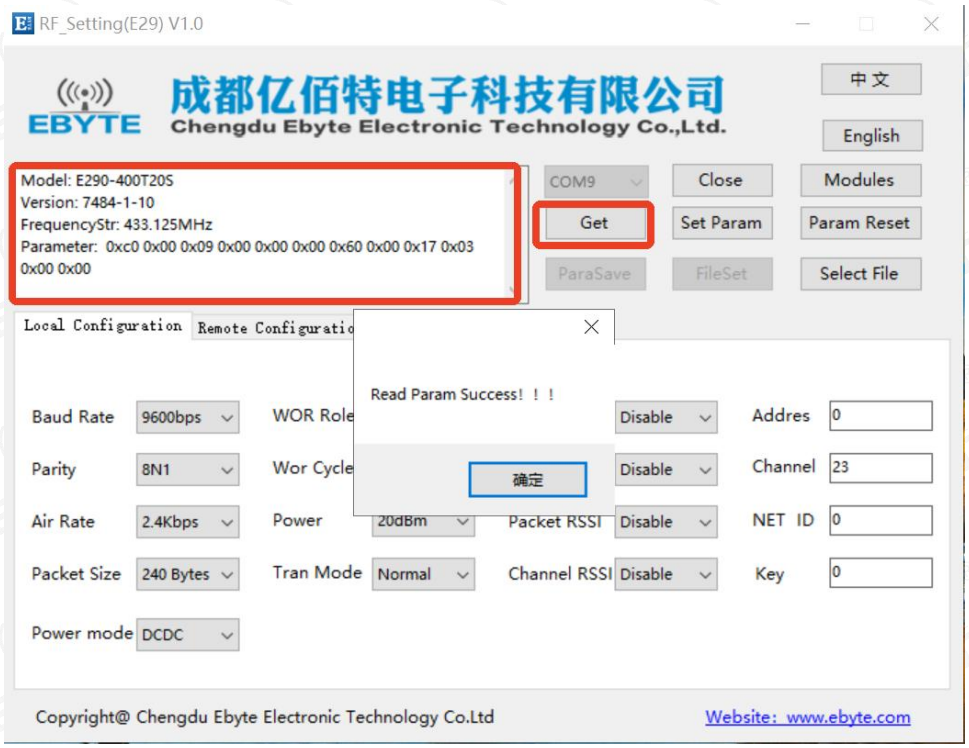
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- **Host computer command upgrade guide**

1. Make the module enter configuration mode by changing M0 and M1 (note: the baud rate in configuration mode is 9600);
2. Open the official website to configure the host computer "RF_Setting(E29) V1.0.exe", select Serial Port > Open Serial Port;



3、Click Read Parameters to view the module information in the left window of the host computer;



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4. Click Firmware Upgrade > Click Open File (select the firmware .bin file) > Click Start Downloading;



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8 Hardware Design

- It is recommended to use a DC regulated power supply to power the module. The power supply ripple coefficient should be as small as possible and the module should be reliably grounded.
- Please pay attention to the correct connection of the positive and negative poles of the power supply. Reverse connection may cause permanent damage to the module.
- Please check the power supply to ensure that it is within the recommended power supply voltage. If it exceeds the maximum value, the module will be permanently damaged.
- Please check the stability of the power supply. The voltage should not fluctuate greatly or frequently.
- When designing the power supply circuit for the module, it is often recommended to retain more than 30% margin, which is conducive to long-term stable operation of the whole machine;
- The module should be kept as far away as possible from parts with large electromagnetic interference, such as power supplies, transformers, and high-frequency wiring;
- High-frequency digital routing, high-frequency analog routing, and power routing must avoid the bottom of the module. If it is necessary to pass under the module, assuming that the module is soldered on the Top Layer, ground copper should be laid on the Top Layer of the module contact part (all copper should be laid and well grounded), and it must be close to the digital part of the module and routed on the Bottom Layer ;
- Assuming the module is soldered or placed on the Top Layer, it is also wrong to randomly route the wires on the Bottom Layer or other layers, which will affect the module's spurious signal and receiving sensitivity to varying degrees ;
- If there are devices with large electromagnetic interference around the module, it will also greatly affect the performance of the module. It is recommended to keep them away from the module according to the intensity of the interference. If possible, appropriate isolation and shielding can be performed.
- If there are traces with large electromagnetic interference around the module (high-frequency digital, high-frequency analog, power traces), it will also greatly affect the performance of the module. It is recommended to keep them away from the module according to the intensity of the interference. If possible, appropriate isolation and shielding can be performed.
- If the communication line uses 5V level, a 1k-5.1k resistor must be connected in series (not recommended, there is still a risk of damage) ;
- Try to stay away from some TTL protocols whose physical layer is also 2.4GHz, such as USB3.0;
- The antenna installation structure has a great impact on the module performance. Make sure the antenna is exposed and preferably vertically upward;
- When the module is installed inside the case, you can use a high-quality antenna extension cable to extend the antenna to the outside of the case;
- The antenna must not be installed inside a metal shell, as this will greatly reduce the transmission distance.

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9 FAQ

9.1 The transmission distance is not ideal

- When there is a straight-line communication obstacle, the communication distance will be attenuated accordingly ;
- Temperature, humidity, and co-channel interference can increase the communication packet loss rate ;
- The ground absorbs and reflects radio waves, so the test results are poor when close to the ground ;
- Seawater has a strong ability to absorb radio waves, so the test effect at the seaside is poor ;
- If there are metal objects near the antenna, or the antenna is placed in a metal shell, the signal attenuation will be very serious ;
- The power register is set incorrectly, or the air rate is set too high (the higher the air rate, the closer the distance) ;
- The power supply voltage at room temperature is lower than the recommended value. The lower the voltage, the lower the power output .
- The antenna used does not match the module well or the antenna itself has quality issues.

9.2 Module is easily damaged

- Please check the power supply to ensure that it is within the recommended power supply voltage. If it exceeds the maximum value, the module will be permanently damaged .
- Please check the stability of the power supply. The voltage should not fluctuate greatly or frequently .
- Please ensure anti-static operation during installation and use, as high-frequency components are sensitive to static electricity ;
- Please ensure that the humidity is not too high during installation and use, as some components are humidity sensitive devices ;
- If there is no special requirement, it is not recommended to use it at too high or too low temperature.

9.3 Bit error rate is too high

- There is interference from the same frequency signal nearby. Stay away from the interference source or change the frequency or channel to avoid interference.
- An unsatisfactory power supply may also cause garbled characters, so the reliability of the power supply must be ensured;
- Extension cables or feeder cables that are of poor quality or are too long can also cause a high bit error rate.

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10 Welding Operation Instructions

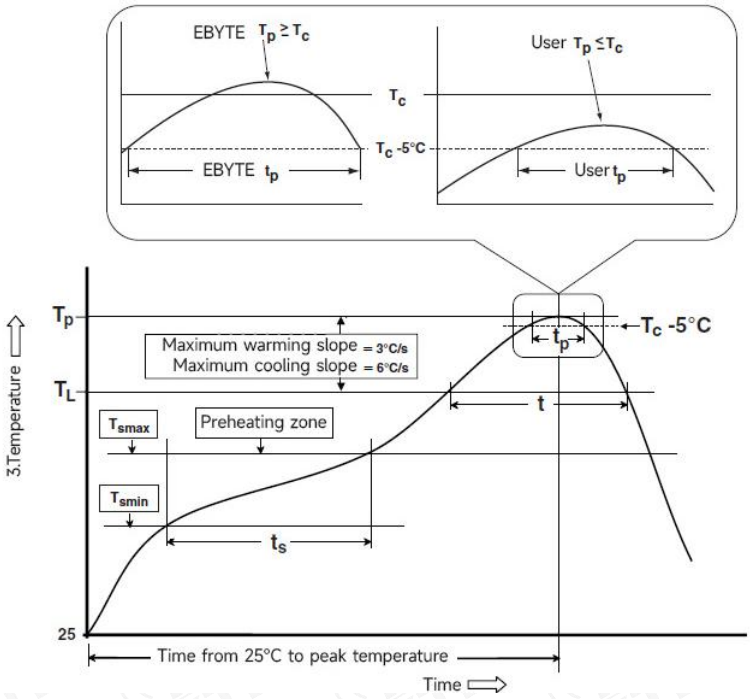
10.1 Reflow temperature

Reflow profile characteristics		Leaded process assembly	Lead-free assembly
Preheating /keeping	Minimum temperature (Tsmin)	100℃	150℃
	Maximum temperature (T smax)	150℃	200℃
	Time (T smin ~T smin)	60-120 seconds	60-120 seconds
Heating slope (T L ~T p)		3℃/sec, max.	3℃/sec, max.
Liquidus temperature (TL)		183℃	217℃
T L above the holding time		60~ 90 seconds	60~ 90 seconds
Package peak temperature Tp		Users must not exceed the temperature stated on the product's "Moisture Sensitivity" label.	Users must not exceed the temperature stated on the product's "Moisture Sensitivity" label.
p) within 5°C of the specified classification temperature (Tc) is shown in the figure below.		20 seconds	30 seconds
Cooling slope (T p ~T L)		6℃/sec, max.	6℃/sec, max.
Time from room temperature to peak temperature		6 minutes, longest	8 minutes, longest
※The peak temperature (Tp) tolerance of the temperature curve is defined as the upper limit of the user			

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10.2 Reflow Oven Profile

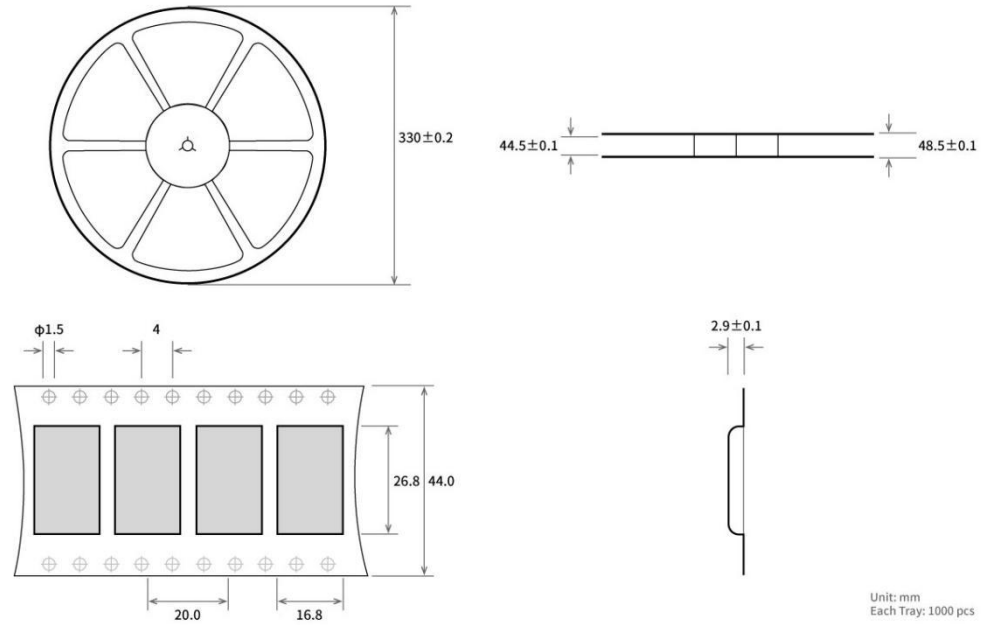


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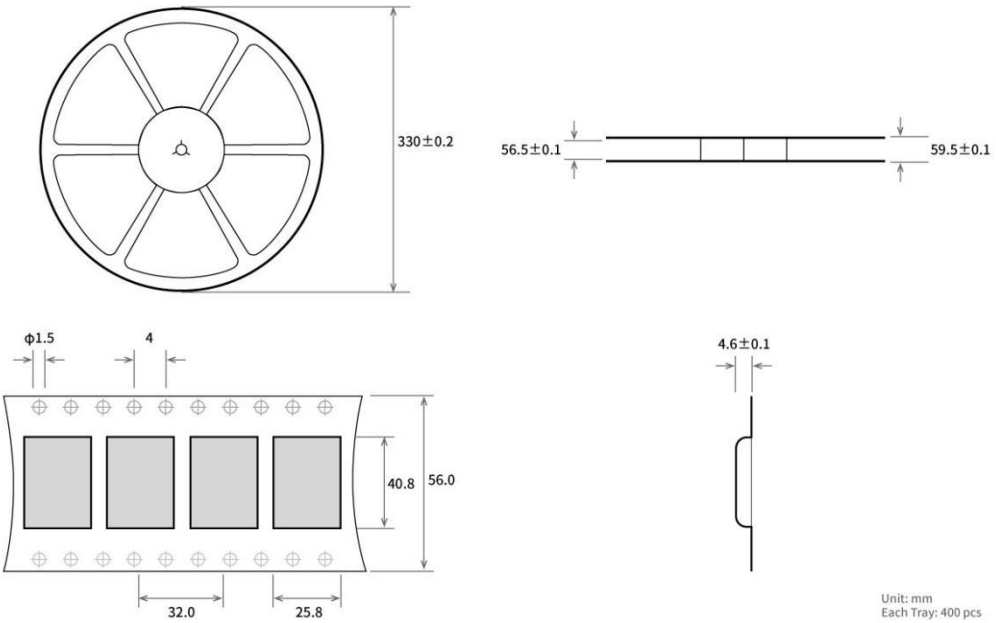
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11 Bulk packaging method

11.1 E290-400/900T20S Batch Packaging



11.2 E290-400T30S Batch Packaging



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Revision History

Version	Revision Date	Revision Notes	Maintainer
1.0	2024-3-29	Initial release	Weng
1.1	2024-11-5	Text and image modification	Hao
1.2	2024-11-7	Model Merge	Hao
1.3	2024-11-21	Modified the description of the heartbeat packet function	Hao
1.4	2025-1-17	WOR added description	Hao

Contact Us

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